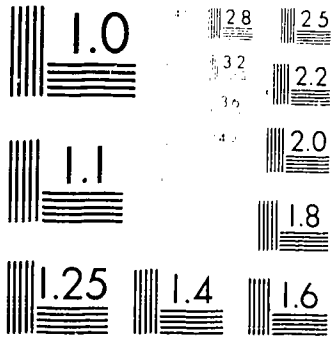
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DOCUMENT RESUME

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ABSTRACT

Appendices A - H to the technical report "Developmental Activities Related to Summative Evaluation" are presented. These are: (1) Evaluation of Standardized Tests; (2) Student Attitude Questionnaire (First Draft); (3) Mean Scores for Dichotomous and Continuous Forms for Each Item in Part I of the Student Attitude Questionnaire (First Draft); (4) Student Attitude Questionnaire (Second Draft); (5) Student Attitude Questionnaire (Final Form); (6) SAQ Validation Report; (7) Problem Solving Survey - Part I; and (8) Stanford Achievement Test - Intermediate Level I, Form A. (MP)

TECHNICAL REPORT IV: SUMMATIVE EVALUATION

APPENDICES A - H

APPENDIX A: Evaluation of Standardized Tests

APPENDIX B: Student Attitude Questionnaire (First Draft)

APPENDIX C: Mean Scores for Dichotomous and Continuous Forms for Each Item in Part I of the Student Attitude Questionnaire (First Draft)

APPENDIX D: Student Attitude Questionnaire (Second Draft)

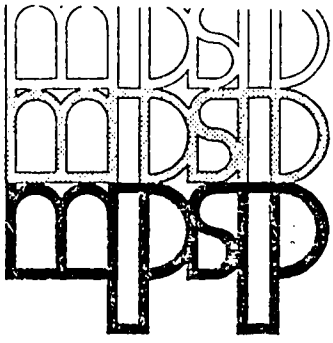
APPENDIX E: Student Attitude Questionnaire (Final Form)

APPENDIX F: SAQ Validation Report

APPENDIX G: Problem Solving Survey - Part I

APPENDIX H: Stanford Achievement Test - Intermediate Level I Form A

MATHEMATICAL PROBLEM SOLVING PROJECT



A Project of the
MATHEMATICS EDUCATION DEVELOPMENT CENTER
Project Supported by
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TECHNICAL REPORT IV: SUMMATIVE EVALUATION

APPENDIX A: Evaluation of Standardized Tests

R. Charles and B. Moses
August, 1975

TECHNICAL REPORT IV: SUMMATIVE EVALUATION

APPENDIX A: Evaluation of Standardized Tests

R. Charles and B. Moses

August, 1975

I. Objectives of the evaluation

A. Do any of the standardized achievement tests measure problem solving ability? If so, to what extent?

B. Which test best measures problem solving ability?

II. Biases of the evaluators

A. Definition: A problem is a situation in which an individual or a group is called upon to perform a task for which that individual or group has no readily accessible procedure for determining a solution (see Lester, 1975).

[Note: This definition of a problem is explicitly dependent upon the individual involved in the situation, i.e., we cannot determine whether a given situation is or is not a problem for that individual unless we know the individual's previous experience and knowledge.]

B. Definition: Problem solving refers to the behavior of an individual in a situation in which previous experience, knowledge, and intuition must be coordinated in an effort to determine an outcome of that situation for which a procedure (e.g., algorithm) for determining the outcome is not known (see Lester, 1975).

C. In order to differentiate between encounters which are problems and those which are not, it was necessary to develop a classifi-

cation scheme which would reflect the various mathematical encounters experienced by elementary school children. Given below is the classification scheme that was developed.*

[Note: See Appendix A for examples of each encounter type.]

1. Computational encounters

   Computational encounters are ones in which the solution can be obtained by directly applying an algorithm.

2. One-or-more-step encounters

   These encounters are ones in which the solution can be obtained by:

   (a) translating the written sentence into a mathematical sentence and then applying one or more times an algorithm(s), or

   (b) directly applying two or more algorithms.

3. Interpretive encounters

   Encounters of this type are ones in which a solution can be obtained by the direct recall and/or application of previously learned definitions and/or skills (excluding the application of algorithms).

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* It is important to note that since a problem was defined in terms of the individual, any attempt at identifying problem types must also reflect the individual's previous experience and knowledge. For example, consider the following encounter: $\begin{array}{r} 38 \\ \times\ 17 \end{array}$

This situation would be considered as a type 1 encounter given that the student knows the appropriate algorithm. On the other hand, if the student does not know the algorithm for multiplying 2-digit by 2-digit numbers, this situation would be classified as a type 4 encounter. In this case, the student's previous knowledge of modeling multiplication as an array would be one procedure that he/she could use in determining the solution.

4. Consolidation encounters

Consolidation encounters are ones in which a solution cannot be obtained by merely applying an algorithm(s). Rather, knowledge (e.g., algorithms, strategies), previous experience, and intuition must be coordinated to obtain a solution.

5. Project/application encounters

Project/application encounters are ones in which a solution process can only be identified after the individual provides additional information to the encounter through experimentation, inquiry, etc.

D. The encounter types given above were identified by considering the process or processes required to obtain a solution. A perusal of the leading elementary and intermediate mathematics textbook series reveals that encounter types 1, 2, and 3 dominate the set of activities called exercises, problems, and/or problem solving.

The reader will have noticed that only encounters 4 and 5 are congruous with our definitions of a problem and problem solving. Therefore, we have taken the following position concerning problem solving in the primary and intermediate mathematics classroom.

1. Mathematical encounters of types 1, 2, and 3 are exercises.
2. Mathematical encounters of types 4 and 5 are problems.
3. A student using the processes required of encounter types 4 and 5 is involved in problem solving.

III. Criteria

Five criteria for an appropriate standardized test of problem solving ability were used for this evaluation. These five criteria are not arranged

in a hierarchy. It is assumed that the criteria are equally important for assessing the quality of a standardized test. The criteria used were the following:

1. A variety of encounter settings should be included (e.g., story, pictorial, and numerical). Also, the settings of the encounters should meet the following criteria:
   (a) The settings should not be dated, e.g., "Suppose we land on the moon some day..."
   (b) The settings should be interesting to the students. For example, are personal words frequently used?... are concrete nonmathematical words frequently used?

2. The vocabulary should be appropriate for the grade level(s). Also the vocabulary should include some specialized mathematical terms (e.g., square).

3. A variety of mathematics content (e.g., concepts, symbols) should be included and should be appropriate for the grade level(s).

4. Some encounters with non-unique solutions should be included.

5. A variety of encounter types should be included. (An appropriate test of problem solving abilities should emphasize encounter types 4 and 5.)

In order to identify criteria we felt it was necessary to examine the differences between encounters. The classification scheme given in part II differentiates between encounters only on the dimension of the solution process. Other dimensions of mathematical encounters were identified by the MPSP staff at Indiana (see Lester, 1975). Those dimensions are:

(1) the setting of the problem (encounter); (2) the complexity of the problem (encounter); (3) strategies applicable for a problem (encounter); and (4) the mathematical content of the problem (encounter). Criteria 2, 4, and 5 are related to the complexity of the problem (encounter). Criterion 1 is related to the setting of the problem (encounter), and criterion 3 is related to the mathematical content. In the categorization scheme of MPSP several components of each dimension are given. The five criteria selected reflect those components which we believe are reasonable ones in view of the way in which standardized tests are administered. (For example, encounters where the student is asked to act out the situation are not expected to be included.)

IV. Description of tests and judgments of the worth of the standardized tests to measure problem solving ability

Eight standardized tests were examined in this study: The California Achievement Tests; The Iowa Tests of Basic Skills (2 levels); The Metropolitan Achievement Tests (2 levels); The SCAT-STEP Test, and The Stanford Achievement Tests (2 levels).

Each test is discussed separately below. For each test, a brief description is given followed by our opinions related to the worth of the instrument. The opinions are numbered from 1-5 to correspond to the five criteria previously discussed. Also, a short summary of each test is provided. For those tests which had two levels, a complete discussion is offered for only one level while a brief summary is given for the other since both levels of the tests are quite similar.

A comparison of all eight tests is given in part V.

California Achievement Tests

Level 3, Form A, 1970 Edition, Grades 4-6

Description

The test is divided into 4 sections: computation, concepts, problems, and fractions, with 48, 25, 15, and 20 items, respectively. The Kuder-Richardson reliability coefficient for level 3 is .63 - .98 as reported in the Technical Bulletin.

1. The arrangement of encounter settings lacks variance within sections of the test. The first section is entirely numerical; the second is pictorial, numerical and story (pictorial settings include bar graphs and thermometers); the third section is entirely story; and the fourth section is entirely numerical.

2. The vocabulary is appropriate for the intermediate grades. Some examples of the specialized mathematics vocabulary are: right angle, rectangle, and average.

3. The mathematics content appears to be appropriate and includes: operations, fractions, numeration, measurement, geometry, percent, and area.

4. All of the encounters have a unique solution.

5. The encounters are of types 1, 2 and 3, with the third section having a majority of type 2 encounters. The first and fourth sections have only type 1 encounters.

Summary:

This test overemphasizes work with fractions; for example, included is an entire section of 20 computation items.

A great deal of symbolization is used, e.g., the meaning of the dollar sign, the degree symbol, etc.

The story encounters are typical of most textbook encounters.

The number of pictorial representations is relatively small and, as a result, the test is less attractive to read.

As a measure of computation, the test is adequate. Otherwise, the test fails to measure the wide scope of abilities that might be needed for problem-solving activities in the intermediate grades.

Iowa Tests of Basic Skills

Form 6, 1971 Edition

Description:

This form deals with mathematical skills and contains 6 subsections based on complexity of content. The reliability coefficients are as follows: Grade 4 (.79 - .98), Grade 5 (.75 - .98), Grade 6 (.70 - .98). The test content has been updated to include current curricular practices and to stress social utility for a varied student population according to educational authorities.

1. Most of the encounter settings are either pictorial or numerical. The pictorial settings include geometric figures and clocks. Due to the variety of pictorial representations, the test is pleasant to look at.

2. The vocabulary is appropriate for the level of the test. Several specialized mathematical words are included such as right angle, average, diameter, addend, intersection, quadrilateral, perimeter, prime, and simple closed curve.

3. The mathematics content is appropriate for the level(s) of the test. The content emphasizes numeration and place value. Other content included: operations, geometry, time, fractions, measurement, money, length, and area.

4. All of the encounters have unique solutions.

5. All of the encounters are either type 1, type 2, or type 3, with the majority being type 2.

Summary:

The encounters in this test assess the necessary (but not sufficient) prerequisite knowledge for fourth and fifth grade problem solving. However, applications of such knowledge to more open-ended encounters, such as type 4 or type 5, are omitted.

Iowa Tests of Basic Skills, Form 5

Form 5 is similar to Form 6. The scope of the mathematics content and vocabulary is not as broad. The variety of encounter settings and encounter types is comparable to that of Form 6. Either test would be an appropriate measure of problem-solving aptitude for the intermediate grades.

Metropolitan Achievement Tests (MAT)

Form F; Intermediate, 1970 Edition

Description:

This form of the MAT provides three sub-scores related to mathematics: computation, concepts, and problem solving. The number of test items in each section are 40, 40 and 35, respectively. The Kuder-Richardson reli-

ability coefficient as given in the Teacher's Handbook, is .88 - .96. As reported in the publisher's manual, the test content is based on analyses of contemporary textbooks, syllabuses, and other curricular sources. The test was designed to measure student performance in the content and skill areas of the curriculum.

1. For the most part the encounter settings are either numerical or story. Moreover, in the problem solving sub-test, the only "picture" provided is one "picture graph." The settings in all the subtests are not dated. The story settings, while containing many concrete nonmathematical words, are nearly all stated in the third person.

2. The vocabulary is appropriate for the intermediate grades. Specialized mathematical terms are generally not used.

3. A variety of mathematics content is included and is appropriate for the intermediate grades. Some content examples are: fractions, operations, numeration, geometry, and measurement.

4. Every problem in all three subtests has a unique solution.

5. The computation subtest contains all type 1 encounters. The concepts subtest contains all type 3 encounters except for three type 4 encounters (numbers 7, 9, and 14). These three encounters are concerned with finding a pattern. The encounters in the problem solving subtest are types 2 and 3 with one step type 2 encounters most frequently used.

Summary:

Although a variety of mathematics content is included and the vocabulary is appropriate for the intermediate grades, a number of weaknesses can be identified. The main weakness is that nearly all the encounters were of types 2 and 3. The only encounters congruous with our definition of a problem were the three type 4 encounters in the concepts subtest.

Metropolitan Achievement Tests (MAT), Form F, Elementary, 1970 Edition

Other than the appropriate change in content, the only difference between the Elementary and Intermediate tests is that one type 4 encounter (number 29) is included in the concepts subtest of the Elementary level while three are included in the Intermediate level.

SCAT-STEP

Series II, 1969 Edition

School and College Ability Tests, Sequential Tests of Educational Progress

Combined Booklet, Form 4A

Description:

This form of the test is divided into three sections: quantitative comparison items, basic concepts, and computation, with 50, 50 and 60 items, respectively. The first section is basically an ability/aptitude test; the other two sections are achievement tests. A reliability coefficient of .83 - .93 for the first section is reported; a reliability coefficient for the next sections is reported as .85 - .94. Obtained scores for the first section correlate fairly highly (.58 - .65) with academic performance. However, due to the variability between schools, such correlation may vary from region to region. The Handbook recommends

that each sc[illegible]test with respect to the [illegible]tional practices and educational objectives of the school.

1. The majority of the encounter settings are numerical or story, with a limited number of pictorial settings (e.g., bar graphs, clock, ruler). The last section is entirely numerical.

2. The vocabulary appears to be appropriate for the intermediate grades. Some of the specialized mathematical words included are: perimeter, perpendicular, prime, and average.

3. A variety of math content is included, particularly in the first section. Included are: fractions, measurement, time, operations, place value, geometry, estimations, and area.

4. All encounters have unique solutions.

5. The computation section contains type 1 and type 3 encounters. The other sections contain a mixture of type 1, 2 and 3 encounters.

Summary:

The test appears very heavy in symbolization, and requires a great deal of abstract thinking. Many items are poorly worded, leaving the student with comprehension problems.

The first section is somewhat unique in its approach of comparing two quantitative solutions. This could be a valuable experience for the student. The test then falls down in its potential for measuring problem-solving ability in the last two sections.

Stanford Achievement Test (SAT)

Form A, Intermed[illegible] Edition

Description:

This form of the SAT provides three sub-scores related to mathematics: computation, concepts, and applications. The number of test items in each section are 40, 32 and 40, respectively. The Kuder-Richardson reliability coefficient for the entire test, as reported in the Norms Booklet, is .86 - .95. As reported in the publisher's manual, the test content is based on analyses from the most widely used textbook series in the subject fields, courses of study, and research literature related to the concepts, experiences, and vocabulary appropriate for the ages and grade levels of interest.

1. The majority of the encounter settings are either numerical or story. There are several encounters which are presented with an accompanying picture. Most of these require the picture to obtain the solution. The applications subtest has six (out of 40) encounters in a pictorial setting. Four of these six require the picture to obtain the solution. Most of the application encounters contain concrete nonmathematical words, but infrequently use personal words.

2. The vocabulary is appropriate for the level of the test. Specialized mathematical words are infrequently used. Some examples of specialized mathematical words that are used are: average, share, and sentence.

3. A variety of mathematics content is included and is appropriate for the level of the test. The mathematics content includes: fractions, operations, numeration, graphing, number sentences, and measurement.

4. All encounters in each subtest have unique solutions. Two encounters (numbers 22 and 29) in the applications subtest do not require the [illegible] find the answer, but rather ask the student to identify [illegible] ional information is needed in order that the encounter can be solved.

5. The computation subtest contains all type 1 encounters. The concepts subtest contains mostly type 3 encounters. However, four (out of 32) (numbers 3, 8, 10, and 13) are encounter type 4 (three of these require the student to find a pattern). All encounters, except two, in the applications subtest are type 2. The two that are not are those mentioned above, in which the student must identify the additional information needed to solve the problem. Many of the type 2 encounters in this subtest are two-step encounters.

Summary:

A variety of mathematics content is included in this test, and the vocabulary is appropriate for the intermediate grades. While more encounters could have been presented in a pictorial setting, several are present, including some where the picture is not necessary. The two encounters which ask the student to identify the additional information needed to solve the encounter are good. More encounters of this type would be appropriate. It is interesting that the only four encounters identified as type 4 are in the concepts subtest. These four encounters require solution processes most congruous to our definition of problem solving. It appears that the applications subtest contains primarily type 2 encounters. Several of these encounters require a two-step solution process.

Therefore, most of the encounters in the applications subtest would be classified as exercises. However, it is important to note that one-step solution processes are not the only type included.

Stanford Achievement , Form A. Intermediate Level II. 1973 Edition

Level II of the SAT is similar to Level I in nearly all respects. The primary difference is in the content emphasis within the topic of rational numbers. While the emphasis in Level I is on operations with the set of whole numbers, the emphasis in Level II is on operations with fractional numbers (primarily with ratios). Another notable difference is that the concepts subtest in Level II contains only two encounters of type 4 while Level I contained four such encounters.

V. Comparison of tests

Since each test was described with respect to the five criteria of an excellent standardized test of problem solving ability, the summary that follows will also be separated into five sections to correspond to the [illegible] criteria.

1. The following conclusions can be made related to the encounter settings of all eight tests: (a) the settings are not dated, (b) concrete nonmathematical words are frequently used, and (c) the settings are for the most part very impersonal. Only two tests contain a variety of encounter settings, the ITBS (both levels). The other tests contain primarily numerical and story settings with few pictorial settings. Moreover, the SAT (both levels) are the only tests which contain pictorial settings where the picture is not necessary to obtain the solution.

2. For all eight tests the vocabulary is appropriate for the level(s) of the test. Also, specialized mathematical words are included in all tests, and the frequency of such words is adequate.

3. All tests contain a variety of mathematics content appropriate for the level(s) of the test.

4. Every encounter in all eight tests has a unique solution. Only the SAT (both levels) contain encounters where the student is asked to identify the additional information needed to solve the encounter rather than identify the solution to the encounter.

5. All eight tests emphasize only encounter types 1, 2, and 3. Type 5 encounters are not included in any test. (We did not expect type 5 encounters to be included due to the nature of standardized tests.)

Only ten type 4 encounters are included: three-MAT, Intermediate; one-MAT, Elementary; four-SAT, Level I; two-SAT, Level II. It is interesting that all the type 4 encounters are found in the "concepts" subtests. This discovery is clearly an anamoly considering the congruity between type 4 encounters and our definitions of a problem and problem solving. The problem solving and/or applications subtests contain nearly all type 2 encounters. Moreover, one-step type 2 encounters are emphasized, with only the SAT (both levels) emphasizing two-step type 2 encounters in the "applications" subtest.

Conclusions:

It appears that all the tests essentially satisfy criteria 1, 2, and 3 for an excellent test of problem solving ability. It should also be noted that the encounter settings, vocabulary, and mathematics content are all typical of most elementary mathematics textbook series. It is clear that criteria 4 and 5 are not satisfied by any of the tests. One can conclude that the encounters experienced on standarized tests of problem solving (application) ability are generally "exercises" rather than "problems." However, it is only fair to point out that the encounters in all the standardized tests are typical of those included in most elementary mathematics textbook series.

VI. Recommendation

Before recommending the use of any standardized test, it is necessary to define the purpose of the evaluation as well as the characteristics (ability, training) of the population being tested. The instrument must be appropriate in terms of the experiences of the student population (appropriate vocabulary, appropriate content), the test items should be

of high quality as judged by the objectives of giving the test, and the test scores should give quantitative measures of everything one wishes to measure. It is not reasonable to expect a perfect correspondence between existing standardized tests and local objectives of a program, but as Wilson explains (Mathematics Teacher, April 1973), dangers in misusing test results abound due to: (1) measuring things that are easy to measure rather than things one wishes to measure; (2) measuring only certain types of outcomes; (3) measuring several components with one score; (4) attempting to measure everything.

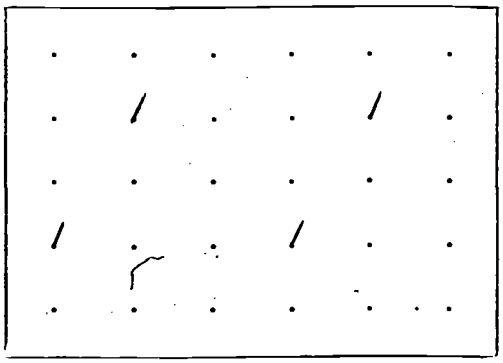
Because of these imminent dangers, it is absolutely necessary to clearly define certain expectations. It is for this reason that much effort in this paper has been devoted to the definitions of a problem and problem-solving, as well as relevant criteria. Based on these a priori objectives, THE STANFORD ACHIEVEMENT TEST, INTERMEDIATE LEVEL I IS RECOMMENDED. (Although Level I and Level II of the Stanford test are quite similar, Level II was not selected because it places a great emphasis on fractions rather than whole numbers, an inappropriate emphasis in terms of the student population involved.)

Neither the mathematics content nor the vocabulary was a factor in the decision-making process; both of these criteria are relatively stable in the eight standardized tests reviewed. The criteria of non-unique solutions also did not play a role since all of the tests contain only encounters with unique solutions. However, the Stanford test does contain two encounters where the student is asked to explain what additional information is needed in order to solve the encounter. This type of reasoning is crucial to good problem-solving.

Although the Stanford test does not contain the variety of encounter settings as does the Iowa test, the two tests are [illegible] similar.

The variety of encounter types is greatest in the Stanford test. It contains four type 4 encounters (more than any other test), three of which require the student to find a pattern. The type 2 encounters are frequently two-step encounters rather than one-step encounters.

In spite of the fact that there are few type 4 encounters, there are several encounters which require good problem-solving techniques from the student. The following example is a good illustration of this:



If you run a string around the four pegs, what figure will you have?

With the existing standardized tests one cannot hope to measure problem-solving abilities directly, but due to the high correlation between efficiency in problem-solving tasks and mathematical skills as measured by standardized tests (see Epstein, 1973), we believe that the Stanford Achievement test with its separate scores in mathematical concepts, mathematical computation, mathematical applications as well as a total mathematics score, can best serve the objectives of the MPSP evaluation.

[Note: The following encounters are classified according to the expected experiences of a student who has completed the third grade.]

Encounter type 1

(a) $\begin{array}{r} 22 \\ \times\ 3 \end{array}$ (b) $2\overline{)46}$ (c) $\begin{array}{r} 49 \\ +\ 56 \end{array}$

Encounter type 2:

(a) Danny bought 4 packs of gum. There were 7 sticks of gun in each pack. How many sticks of gum did Danny buy?

(b) Jean bought 3 tomatoes for 15¢ each and 2 onions for 20¢ each. How much money did Jean spend altogether?

Encounter type 3:

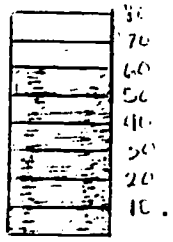
Fifteen couples are going to a birthday party. Small square tables that can seat one person on a side are going to be put together to make a long table. How many tables will be needed to seat the 30 people who are coming to the party?

Encounter type 4:

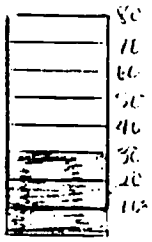
You are planning a trip from New York to Chicago for your club of 100 members. You have a choice of four ways to go: cars, busses, a train, or an airplane. You want to save energy so you wish to select the way which uses the least fuel. How should you travel?

Encounter type 5:

(a)



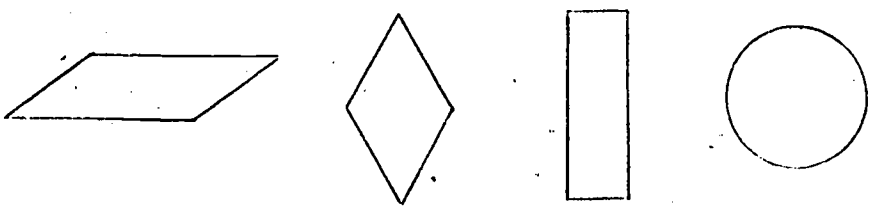
Florida



Wyoming

How many degrees warmer is it in Florida than in Wyoming?

(b) Which of the following figures is a rectangle?



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TECHNICAL REPORT IV: SUMMATIVE EVALUATION

APPENDIX B: Student Attitude Questionnaire
(First Draft)

TECHNICAL REPORT IV: SUMMATIVE EVALUATION

APPENDIX B: Student Attitude Questionnaire
(First Draft)

NAME _____ SCHOOL _____ DATE _____

Part I: Instructions

Let's pretend that your class has been given some math story problems to solve. Here are some things that other students have said about solving story problems.

Let's look at an example to see how you should mark your answers.

EXAMPLE

I like apples.

	Agree				Disagree
(Tom)	(1)	2	3	4	5
(Sally)	1	(2)	3	4	5
(Linda)	1	2	(3)	4	5
(Jack)	1	2	3	(4)	5
(Herb)	1	2	3	4	(5)

DO NOT TURN THE PAGE

(REMEMBER, THERE ARE NO RIGHT OR WRONG ANSWERS)

1. If a problem seems too hard for me, I don't like to try it.

Agree				Disagree
1	2	3	4	5

2. I am a good problem solver.

Agree				Disagree
1	2	3	4	5

3. Most problems are too hard for me to solve.

Agree				Disagree
1	2	3	4	5

4. I don't give up on a problem quickly even if I have trouble solving it.

Agree				Disagree
1	2	3	4	5

5. I don't like to try problems that I don't know how to start.

Agree				Disagree
1	2	3	4	5

6. If I get an idea for a problem that is different from everyone else's, the idea is probably not very good.

Agree				Disagree
1	2	3	4	5

7. I keep working on problems until I get them right.

Agree				Disagree
1	2	3	4	5

GO ON TO THE NEXT PAGE

8. It is fun to try to solve problems.

Agree				Disagree
1	2	3	4	5

9. I am not very good at solving problems.

Agree				Disagree
1	2	3	4	5

10. If I can't get the answer right away for a problem, I would want to go on to the next one.

Agree				Disagree
1	2	3	4	5

11. If I was asked to work on a problem I would probably have to get someone to help me.

Agree				Disagree
1	2	3	4	5

12. I like to get an answer to a problem quickly whether the answer is right or wrong.

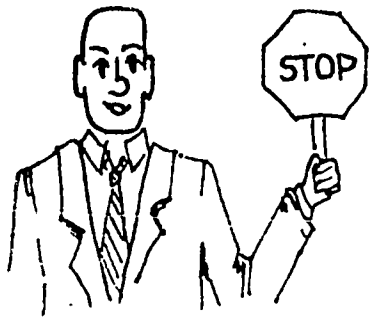
Agree				Disagree
1	2	3	4	5

13. Even though I might not be able to solve a problem I am still willing to try.

Agree				Disagree
1	2	3	4	5

14. I have confidence in my ability to solve problems.

Agree				Disagree
1	2	3	4	5



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Part II: Instructions

For this part you will read a problem and then be asked how you feel about some things that someone else has said about the problem.

Let's look at an example to see how you should mark your answers.

EXAMPLE

28 x 4 = ?

1. I like this problem.

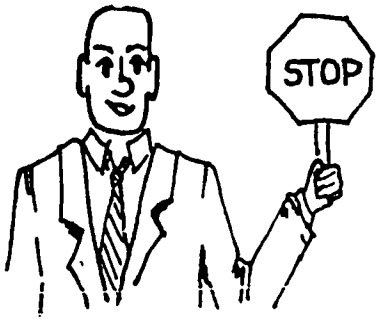
Agree				Disagree
1	2	3	4	5

2. This problem looks hard.

Agree				Disagree
1	2	3	4	5

THERE ARE NO RIGHT OR WRONG ANSWERS.

If you have any questions during this part, raise your hand.



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(REMEMBER: JUST READ THE PROBLEMS--DO NOT TRY TO SOLVE THEM.)

1. It cost 25 cents to use each washer and 10 cents to use each dryer. How much did Mrs. Jackson spend to wash clothes if she used two washers and three dryers?

a. I would like to try to solve this problem.

Agree				Disagree
1	2	3	4	5

b. I think I can solve this problem.

Agree				Disagree
1	2	3	4	5

c. If I start this problem I would keep working on it until I solved it.

Agree				Disagree
1	2	3	4	5

2. Mother baked 14 cookies. Three children shared the cookies. How many cookies did each child get? Were there any cookies left over?

a. I would like to try to solve this problem.

Agree				Disagree
1	2	3	4	5

b. I think I can solve this problem.

Agree				Disagree
1	2	3	4	5

c. If I start this problem I would keep working on it until I solved it.

GO ON TO THE NEXT PAGE

3. You are planning a trip from New York City to Chicago for your club of 100 members. You have a choice of four ways to go: cars, busses, a train, or an airplane. You want to save energy so you want to select the way which uses the least fuel. How should you travel?

a. I would like to try to solve this problem.

Agree				Disagree
1	2	3	4	5

b. I think I can solve this problem.

Agree				Disagree
1	2	3	4	5

c. If I start this problem I would keep working on it until I solved it.

Agree				Disagree
1	2	3	4	5

4. There are 8 people in Tom's "ping-pong" club. How many games must be played in which every person plays each other person just once?

a. I would like to try to solve this problem.

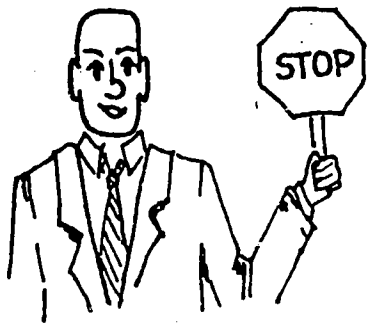
Agree				Disagree
1	2	3	4	5

b. I think I can solve this problem.

Agree				Disagree
1	2	3	4	5

c. If I start this problem I would keep working on it until I solved it.

Agree				Disagree
1	2	3	4	5



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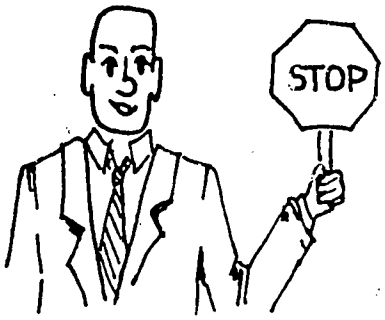
Part III: Instructions

On the next two pages there are some problems to read and some questions to answer.

Circle the answer to each question which best tells how you feel about the question.

There are no right or wrong answers.



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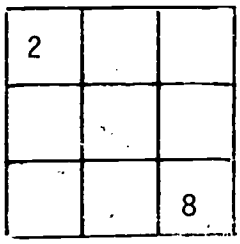
READ (DO NOT TRY TO SOLVE) PROBLEMS A, B, AND C AND ANSWER THE QUESTIONS BELOW.

Problem A. You are planning a trip from New York to Chicago for your club of 100 members. You have a choice of four ways to go: cars, busses, a train, or an airplane. You want to save energy so you want to select the way which uses the least fuel. How should you travel?

Problem B. Look at the square below. Use each number from 1 to 9 one time to fill in the small squares so that each column, each row, and each diagonal add up to 15. Two squares have already been filled for you.



Problem C. Pam helped in the school cafeteria 5 days a week for 6 weeks. She did not have to pay for her lunch during that time. School lunches cost 40 cents. Pam's mother wants to pay her the money she saved on lunches. How much should her mother pay her?

QUESTIONS

(CIRCLE YOUR ANSWER--REMEMBER, THERE ARE NO RIGHT OR WRONG ANSWERS.)

1. If your teacher told you that you had to try one of these three problems, which one would you choose? A B C

2. Suppose your teacher said you now had to try one of the remaining two problems. Which one would you choose next? A B C

3. How many of these problems would you like to try? 0 1 2 3

GO ON TO THE NEXT PAGE

READ (DO NOT TRY TO SOLVE) PROBLEMS D, E, AND F AND ANSWER THE QUESTIONS BELOW.

Problem D. Last night I saw some chickens and rabbits at a farm. I decided to count how many chickens were there and how many rabbits were there. I decided to count them in a different way. I counted legs and found there were 30 legs. How many chickens and how many rabbits were there?

Problem E. Jack had twice as much money as Betty. When Jack gave Betty 5¢, they had the same amount. How much did Jack start with?

Problem F.

9	15	13
x 7	x 6	x 8

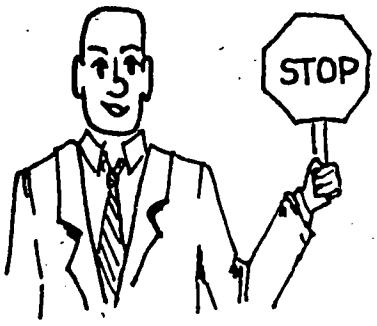
QUESTIONS

(CIRCLE YOUR ANSWERS: REMEMBER, THERE ARE NO RIGHT OR WRONG ANSWERS.)

1. If your teacher told you that you had to try one of these three problems, which one would you choose? D E F

2. Suppose your teacher said you now had to try one of the remaining two problems. Which one would you choose next? D E F

3. How many of these problems would you like to try? 0 1 2 3



TECHNICAL REPORT IV: SUMMATIVE EVALUATION

APPENDIX C: Mean Scores for Dichotomous and Continuous Forms for Each Item in Part I of the Student Attitude Questionnaire (First Draft)

Barbara E. Moses
July, 1975

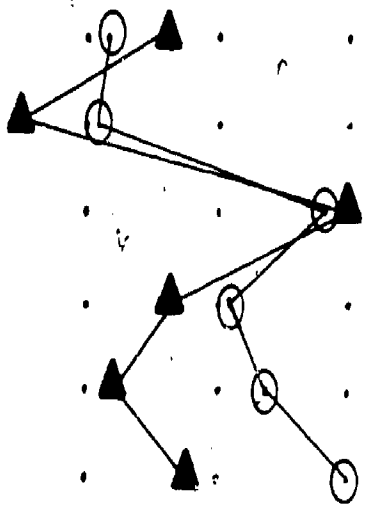
▲ Dichotomous Form

○ Continuous Form

IV C-1

	1 2 3 4 5	Mean for Dichot. Form	Mean for Contin. Form	"Expected" Value
Willingness				
1. Hard problem -- won't try		3.33	3.5	5
5. Won't try if don't know how to start		1.67	2.71	5
8. Fun to solve problems		1.83	2.21	1
13. Can't solve but will try		1.67	2.29	1
Perseverance				
4. Don't give up if have trouble solving		1.67	1.79	1
7. Keep working until solution		1.5	2.21	1
10. If don't get answer, go on to next		3	3.07	5
12. Like answer quick		3.33	3.57	5

	1	2	3	4	5	Mean for Dichot. Form	Mean for Contin. Form	"Expected" Value
Self-confidence								
2. Good problem-solver	•	•	•	•	•	2.67	2.14	1
14. Confidence in ability	•	•	•	•	•	1.5	2.07	1
3. Problems too hard	•	•	•	•	•	4	3.86	5
6. If idea different, no good	•	•	•	•	•	2.67	3.07	5
9. Not good at solving problems	•	•	•	•	•	2.25	3.43	5
11. Need help in solving problems	•	•	•	•	•	2.83	4	5



TECHNICAL REPORT IV: SUMMATIVE EVALUATION

APPENDIX D: Student Attitude Questionnaire (Second Draft)

TECHNICAL REPORT IV: SUMMATIVE EVALUATION

APPENDIX D: Student Attitude Questionnaire
(Second Draft)

NAME _____ SCHOOL _____ DATE _____

Part I: Instructions

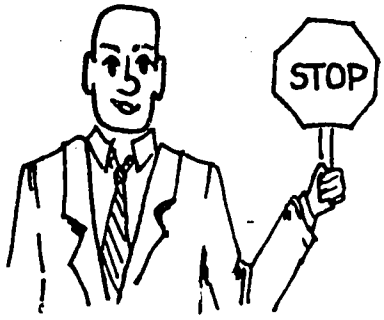
Let's pretend that your class has been given some math story problems to solve. Here are some things that other students have said about solving story problems. Circle the number that best tells how you feel about the sentence.

Let's look at an example to see how you should mark your answers.

EXAMPLE

I like apples.

	Agree				Disagree
(Tom)	(1)	2	3	4	5
(Sally)	1	(2)	3	4	5
(Linda)	1	2	(3)	4	5
(Jack)	1	2	3	(4)	5
(Herb)	1	2	3	4	(5)



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(REMEMBER, THERE ARE NO RIGHT OR WRONG ANSWERS)

1. If a problem seems hard for me, I don't like to try it.

Agree				Disagree
1	2	3	4	5

2. I am a good problem solver.

Agree				Disagree
1	2	3	4	5

3. Most problems are too hard for me to solve.

Agree				Disagree
1	2	3	4	5

4. I don't give up on a problem quickly even if I have trouble solving it.

Agree				Disagree
1	2	3	4	5

5. I don't like to try problems that I have to think about a lot before I get started.

Agree				Disagree
1	2	3	4	5

6. If I get an idea for a problem that is different from everyone else's, the idea is probably not very good.

Agree				Disagree
1	2	3	4	5

7. I keep working on problems until I get them right.

Agree				Disagree
1	2	3	4	5

GO ON TO THE NEXT PAGE

8. It is fun to try to solve problems.

Agree				Disagree
1	2	3	4	5

9. I am not very good at solving problems.

Agree				Disagree
1	2	3	4	5

10. If I can't get the answer right away for a problem, I would want to give up on that problem and go on to the next one.

Agree				Disagree
1	2	3	4	5

11. If I was asked to work on a problem I would probably have to get someone to help me.

Agree				Disagree
1	2	3	4	5

12. I like to get an answer to a problem quickly whether the answer is right or wrong.

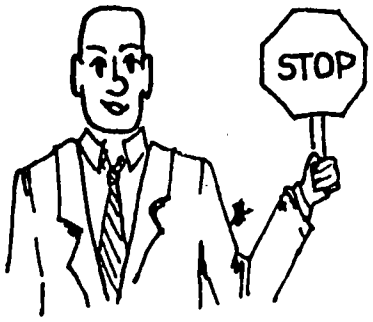
Agree				Disagree
1	2	3	4	5

13. Even though I might not be able to solve a problem I am still willing to try.

Agree				Disagree
1	2	3	4	5

14. I have confidence in my ability to solve problems.

Agree				Disagree
1	2	3	4	5



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Part II: Instructions

Here are some problems to read. After reading the problems circle the answer to each question which best tells how you feel. There are no right or wrong answers.

Example:

Read (do not try to solve) problems A, B, and C and answer the questions.

A. $\begin{array}{r} 45 \\ +\ 8 \\ \hline \end{array}$

B. Jake has 5¢ and Jenny has 8¢. How much money do they have all together?

C. $\begin{array}{r} 6 \\ \times\ 5 \\ \hline \end{array}$

1. If your teacher told you that you had to try one of these three problems, which one would you choose?

   A B C

2. Why did you pick that one? (Circle your reason, you may circle more than one.)

   a. It was the easiest.

   b. It was the shortest.

   c. It was like problems I had done in math class.

   d. It was easy to read.

   e. I liked the story.

   f. I knew how to do it.

   g. It was the first problem.

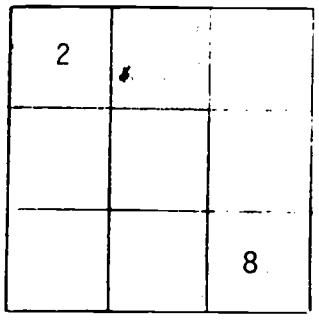
STOP

DO NOT TURN THE PAGE

(REMEMBER: JUST READ THE PROBLEMS--DO NOT TRY TO SOLVE THEM.)

A. You are planning a trip from New York to Chicago for your club of 100 members. You have a choice of four ways to go: cars, busses, a train, or an airplane. You want to save energy so you want to select the way which uses the least fuel. How should you travel?

B. Use each number from 1 to 9 one time to fill in the small squares so that each column, each row, and each diagonal add up to 15. Two squares have already been filled for you.



C. Pam helped in the school cafeteria 5 days a week for 6 weeks. She did not have to pay for her lunch during that time. School lunches cost 40 cents. Pam's mother wants to pay her the money she saved on lunches. How much money should her mother pay her?

Questions

Circle your answer.

1. If your teacher told you that you had to try one of these three problems, which one would you choose?

   A B C

2. Why did you pick that one? (You may choose more than one.)

   a. It was the easiest.

   b. It was the shortest.

   c. It was like problems I had done in math class.

   d. It was easy to read.

   e. I liked the story.

   f. I knew how to do it.

   g. It was the first problem.

3. Suppose your teacher said to try one of the remaining two problems. Which one would you choose next?

   A B C

4. Why did you pick that one? (You may choose more than one.)

   a. It was the easiest.

   b. It was the shortest.

   c. It was like problems I had done in math class.

   d. It was easy to read.

   e. I liked the story.

   f. I knew how to do it.

   g. It was the first problem.

5. How many of the problems would you like to try?

   0 1 2 3

GO ON TO THE NEXT PAGE

(REMEMBER: JUST READ THE PROBLEMS--DO NOT TRY TO SOLVE THEM.)

D. Last night I saw some chickens and rabbits at a farm. I decided to count how many chickens were there and how many rabbits were there. I decided to count them in a different way. I counted legs and found there were 30 legs. How many chickens and how many rabbits were there?

E. Jack had twice as much money as Betty. When Jack gave Betty 5¢, they had the same amount. How much money did Jack start with?

F. Solve each of the following:

9	15	13
x 7	x 6	x 8

Questions

Circle your answer.

1. If your teacher told you that you had to try one of these three problems, which one would you choose?

   D E F

2. Why did you pick that one? (You may choose more than one.)

   a. It was the easiest.

   b. It was the shortest.

   c. It was like problems I had done in math class.

   d. It was easy to read.

   e. I liked the story.

   f. I knew how to do it.

   g. It was the first problem.

3. Suppose your teacher said to try one of the remaining two problems. Which one would you choose next?

   D E F

4. Why did you pick that one? (You may choose more than one.)

   a. It was the easiest.

   b. It was the shortest.

   c. It was like problems I had done in math class.

   d. It was easy to read.

   e. I liked the story.

   f. I knew how to do it.

   g. It was the first problem.

5. How many of the problems would you like to try?

   0 1 2 3

STOP

TECHNICAL REPORT IV: SUMMATIVE EVALUATION

APPENDIX E: Student Attitude Questionnaire (Final Form)

TECHNICAL REPORT IV: SUMMATIVE EVALUATION

APPENDIX E: Student Attitude Questionnaire
(Final Form)

PART 1: Instructions

Pretend your class has been given some math story problems to solve. Mark true or false depending on how the statement describes you. There are no right or wrong answers for this part.

Example 0:

I like math problems. A. True B. False

	A	B	C	D	E
0.	T	F			

If this statement is true of you fill in the box under A marked T. If your answer is false fill in the box under B marked F. Only use the first two boxes. DO NOT use any of the other boxes.

Example 00:

I like math problems about sports. A. True B. False

	A	B	C	D	E
00.	T	F			

Fill in the box under A if your answer is true. If your answer is false fill in the box under B. DO NOT use any of the other boxes.

Mark all of your answers on the answer sheet beginning with number 1.

DO NOT TURN THE PAGE
UNTIL ASKED TO DO SO

MPSP/SAQ

1.	I will put down any answer just to finish a problem.	A. True	B. False
2.	It is no fun to try to solve problems.	A. True	B. False
3.	I will try almost any problem.	A. True	B. False
4.	When I do not get the right answer right away I give up.	A. True	B. False
5.	I like to try hard problems.	A. True	B. False
6.	My ideas about how to solve problems are not as good as other students' ideas.	A. True	B. False
7.	I can only do problems everyone else can do.	A. True	B. False
8.	I will not stop working on a problem until I get an answer.	A. True	B. False
9.	I am sure I can solve most problems.	A. True	B. False
10.	I will work a long time on a problem.	A. True	B. False
11.	I am better than many students at solving problems.	A. True	B. False
12.	I need someone to help me work on problems.	A. True	B. False

GO ON TO THE NEXT PAGE

13.	I can solve most hard problems.	A. True	B. False
14.	There are some problems I just will not try.	A. True	B. False
15.	I do not like to try problems that are hard to understand.	A. True	B. False
16.	I will keep working on a problem until I get it right.	A. True	B. False
17.	I like to try to solve problems.	A. True	B. False
18.	I give up on problems right away.	A. True	B. False
19.	Most problems are too hard for me to solve.	A. True	B. False
20.	I am a good problem solver.	A. True	B. False

TECHNICAL REPORT IV: SUMMATIVE EVALUATION

APPENDIX F: SAQ Validation Report

Barbara E. Moses
June, 1976

TECHNICAL REPORT IV: SUMMATIVE EVALUATION

APPENDIX F: SAQ Validation Report

Barbara E. Moses
June, 1976

Success in mathematical problem solving depends on affective variables as well as cognitive variables. In an attempt to measure various attitudes toward problem solving, the Student Attitude Questionnaire (SAQ) was developed.

The SAQ is a group-administered paper-pencil inventory to assess problem solving attitudes among upper elementary school children.

Construction of the SAQ

The original form of the SAQ included 14 statements to which the student had to agree or disagree. These 14 items were selected from a list of 136 items collected from several sources including the Childhood Attitude Inventory for Problem Solving (Covington, 1966). Ten judges sorted the 136 items into four categories and then ranked the items in each category as to how well the item expressed the attitude of that category. One category (curiosity) lacked cohesiveness; the remaining three categories constituted the SAQ, namely: willingness to engage in problem-solving activities, perseverance during the problem-solving process, and self-confidence with respect to problem solving. Only those items ranked high by a majority of the judges were included.

The SAQ was administered to three classes containing a heterogeneous group of grade levels. Two modes of responding were used: dichotomous (Agree/Disagree) and a five-point scale (Agree 1 2 3 4 5 Disagree). As a result of these tryouts, some rewording changes were made, and the new form contained 20 items to be answered on a dichotomous scale (True/False).

By breaking each category into three dimensions, it was clear that several new items should be included. Willingness was broken down into three dimensions: gutting, cooperating and liking. Gutting represented the willingness to go along with something--it is the thing to do. Liking represented the willingness to engage in something because it is fun--I like to do it.

Perseverance was separated into three dimensions: desire to obtain the right answer, resistance to premature closure and stick-to-itiveness. The first refers to the attitude of sticking with the task until the right answer is found. The second refers to sticking with the task until any answer is found, that is, resisting closure before it is called for. The last refers to the attitude of not giving up too quickly, of staying on task with or without getting an answer.

Self-confidence was also broken down into three dimensions: belief to succeed, comparison with others, and guts. The first refers to a confidence that success will be reached most of the time. The second dimension represents the person's self-confidence with respect to his classmates. The last dimension refers to a person's guts in attempting to solve difficult problems.

The final form of the SAQ is listed in Table 1, along with the scale, the dimension, and whether the item was positively worded or negatively worded. About half the items on each scale were worded in the direction of a favorable attitude toward mathematics.

The resulting version of the SAQ was administered twice, pre- and posttest, at the beginning and the end of the academic shcool year to approximately 900 upper elementary school children in Oakland Schools, Michigan. The questionnaire was also given to a group of approximately 100 fifth graders in Indiana in order to aid in the development of a reliable instrument.

Statistical Analysis of the SAQ

- Item Analysis and Reliability Measures -

Each item on the questionnaire was coded as 0 or 1, where 1 represented a more positive attitude toward mathematics. The mean scores for each item are listed in Table 2. Total scores on willingness, perseverance, and self-confidence were computed, as well as the Kronbach - α, a measure of internal consistency reliability (Table 3). Since the correlation of item 1 and total score on perseverance was only .2024 and the correlation of item 7 and total score on confidence was only .0837, both of these items were deleted from the final statistics.

In addition to the Kronbach - α, the SAQ was checked for reliability by test-retest procedures (two weeks interviewing) with the Indiana group. Pearson product-moment correlations for each of the three scales and the total score was computed. The correlation for willingness was .5680, for perseverance .3596, for self-confidence .7072, and for the total score .7138. These are all significant at the .001 level.

- Validity Measures -

Content validity was established by the initial selection of the items by 10 judges.

A factor analysis was performed to test if the 18 remaining items would factor into the three scales (willingness, perseverance, and self-confidence). The loadings for each factor are given in Table 4. It will be noted that items 6, 11, 12, 13, 19, and 20 loaded highest on Factor 1 (all self-confidence items); items 8, 10 and 16 loaded highest on Factor 3 (all self-confidence items). Item 9 loaded highest on Factor 4 and items 4 and 18 loaded highest on Factor 5. The three scales factor as expected.

In addition to the factor analysis, other measures of affective behavior were taken with the Bloomington population. Individual interviews were conducted with a small sample of the Bloomington population. The students were then ranked by the interviewer. These rankings correlated .90 with the total scores on the SAQ. The teachers of each of the students in the Bloomington population were then asked to rank all of their students with respect to the three scales into the upper third of the class, middle third, or lower third. The correlations between each of these ratings and each of the subscales on the SAQ were much lower (from .21 to .50).

Finally, the Bloomington population was given five NLSMA attitude scales (Arithmetic vs. Non-Arithmetic, Ideal Arithmetic Self-Concept, Pro-Arithmetic Composite, Arithmetic Fun vs. Dull, and Arithmetic Easy vs. Hard). These scales were administered in order to validate whether the SAQ measured something different from other existing attitude scales. The low correlations seemed to establish this point.

- Conclusions -

The results of the statistical analysis show that the SAQ does effectively measure some aspect of the affective nature of mathematical problem solving with elementary school children. The three subscales appear to be distinct and internally consistent.

Future research might do well to expand the questionnaire to include a larger set of items. In addition, the responses might be made in the form of a three-point scale (Agree 1 2 3 Disagree). The SAQ might also be used as a predictive measure of success in problem solving. As such, it could prove to be an effective instrument for the classroom teacher.

REFERENCES

Covington, Martin V., "A Childhood Attitude Inventory for Problem Solving," Journal of Educational Measurement, Vol. 3, No. 3, Fall '66, pp. 234 ff.

TABLE 1

Item	Scale	Dimension	Pos.	Neg.
*1. I will put down any answer just to finish a problem.	P	Resistance to Premature Closure		X
2. It is no fun to try to solve problems.	W	Liking		X
3. I will try almost any problem.	W	Cooperating	X	
4. When I do not get the right answer right away.	P	Right Answer		X
5. I like to try hard problems.	W	Gutting	X	
6. My ideas about how to solve problems are not as good as other students' ideas.	SC	Comparison		X
*7. I can only do problems everyone else can do.	SC	Guts		X
8. I will not stop working on a problem until I get an answer.	P	Resistance to Premature Closure	X	
9. I am sure I can solve most problems.	SC	Belief to Succeed	X	
10. I will work a long time on a problem.	P	Stick-to-itiveness	X	
11. I am better than many students at solving problems.	SC	Comparison	X	
12. I need someone to help me work on problems.	SC	Belief to Succeed		X
13. I can solve most hard problems.	SC	Guts	X	
14. There are some problems I just will not try.	W	Cooperating		X
15. I do not like to try problems that are hard to understand.	W	Gutting		X
16. I will keep working on a problem until I get it right.	P	Right Answer	X	
17. I like to try to solve problems.	W	Liking	X	
18. I give up on problems right away.	P	Stick-to-itiveness		X
19. Most problems are too hard for me.	SC	Belief to Succeed		X
20. I am a good problem solver.	SC	Belief to Succeed	X	

* Item omitted from final statistics.

TABLE 2

Item	Mean	Standard Deviation
1	.9368	.2435
2	.7607	.4269
3	.8239	.3811
4	.9412	.2353
5	.7418	.4379
6	.5351	.4991
7	.8420	.3650
8	.6753	.4685
9	.7130	.4526
10	.6467	.4783
11	.3941	.4889
12	.7568	.4293
13	.6900	.4627
14	.6056	.4890
15	.5271	.4995
16	.7051	.4563
17	.8744	.3315
18	.9603	.1953
19	.7839	.4118
20	.6712	.4700

TABLE 3

	Mean	Standard Deviation	Alpha
Willingness (based on 6 points)	4.34144	1.54060	.63714
Perseverance (based on 6 points)	3.93981	1.15078	.54719
Self-Confidence (based on 8 points)	4.55324	1.99232	.73149
TOTAL (based on 20 points)	12.83449	3.63186	.79084

TABLE 4

Item	Factor 1	Factor 2	Factor 3
2	.16	.42	.05
3	.13	.44	.17
4	.10	.11	.09
5	.27	.51	.21
6	.43	.14	.02
8	.01	.11	.66
9	.19	.14	.12
10	.20	.11	.39
11	.52	.14	.14
12	.46	.14	.06
13	.45	.27	.09
14	.07	.39	.09
15	.11	.39	.03
16	.04	.17	.64
17	.08	.47	.08
18	.06	.15	.06
19	.47	.11	-.02
20	.61	.24	.14

APPENDIX G: Problem Solving Survey, Part I

PART 2: Instructions

This is not a test. There are examples and problems to work. There are questions to answer.

There may be things you cannot do. Don't worry. Some of the things that are easy for you may be hard for other boys and girls.

You are not expected to do all the problems. First, do those that you can. Skip the ones that you cannot answer. When you have done this go back and try those that you left out. Don't be afraid to try.

Here are two examples. The first one is already marked for you.

Example 0:

What is the next counting number after 12?

(A) 14
(B) 11
(C) 22
(D) 13

Answer Ex. 0.

A	B	C	D	E
T	F		■	

The next counting number after 12 is 13. See how Box D has been blackened?

Now try the next example.

Example 00:

Here are some addition facts. How many have 5 as the sum? Mark your answer in the space provided.

4 + 1 = 5
2 + 3 = 5
2 + 2 = 4
3 + 2 = 5

(A) All of them
(B) Three of them
(C) One of them
(D) My answer is not given

Answer Ex. 00.

A	B	C	D	E
T	F			

You know that 2 + 2 = 4 does not have 5 for the sum. The other three do. The answer is B, "three of them." You should have blackened in Box B.

Mark all of your answers on the answer sheet.

STOP HERE

DO NOT GO ON UNTIL YOU ARE TOLD TO BEGIN

MPSP, Form PSS-MC

21. June's mother made 48 butter cookies.
She also made 64 sugar cookies.
She made how many fewer butter cookies than sugar cookies?
On the answer sheet mark the letter of your answer.

(A) 112
(B) 48
(C) 26
(D) 24
(E) 16

22. Ann has 30 cents to spend for pencils.
Each pencil costs 5 cents.
How many pencils can Ann buy?
Mark the letter of a number sentence that can be used with this problem.

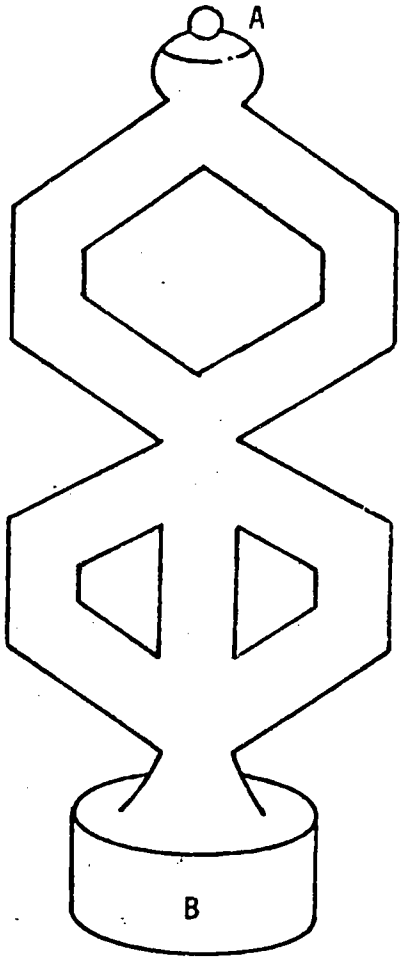
(A) $n = 30 - 5$
(B) $n = 30 \div 5$
(C) $n = 5 \times 30$
(D) $n = 30 + 5$

23. Don bought a bag of 20 new marbles.
He now has 75 marbles.
How many marbles did Don have before he bought the new ones?
Mark the letter of a number sentence that <u>cannot</u> be used with this problem.

(A) $20 + 75 = n$
(B) $75 = 20 + n$
(C) $n + 20 = 75$
(D) $n = 75 - 20$

GO ON TO THE NEXT PAGE

24. Suppose you have a marble game.
You drop a marble at A.
It goes to B.
How many ways can it go?



Mark the letter of the number of ways the marble can go.

(A) Two ways.
(B) Four ways.
(C) Five ways.
(D) Six ways.
(E) The number of ways is not given.

GO ON TO THE NEXT PAGE

25. Look at the chart at the right. Some numbers are needed to complete it.
What would you write instead of the question mark ? in the ring?
Mark the letter of your answer.

(A) 3
(B) 4
(C) 10
(D) 13
(E) My answer is not given.

	Mon.	Tues.	Wed.	Total
Bill	5	3	2	10
Joe	4	8	?	?
Tom	1	7	3	11
Total	10	18	?	37

GO BACK AND TRY THINGS YOU DID NOT DO
IN PART 2 ONLY

TECHNICAL REPORT IV: SUMMATIVE EVALUATION

APPENDIX H: Stanford Achievement Test
Intermediate Level I
Form A

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